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TRUE MAHOGANY.

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INTRODUCTION.

The name "mahogany" is applied commercially to more than 50 different woods. True mahogany, however, is produced by only two closely related species of trees (*Swietenia mahagoni* Jacq. and *Swietenia macrophylla* King), which are natives of tropical America. These were looked upon as the same species (*Swietenia mahagoni*) until long after mahogany had become well known in the timber trade of the world, so that when a botanical distinction between them was finally recognized it was only natural that the same name should continue to be applied to the wood of both.

There appears to be a widespread popular belief that true mahogany may be had from many parts of the world. As a matter of fact, true mahogany grows naturally only from the tropical part of Florida and adjacent keys and islands to the northern part of South America (fig. 1). The extensive commercial use of the name "mahogany," either with or without a qualifying adjective, such as African, Indian, Philippine, etc., for so many other woods indicates that the characteristics and sources of supply of true mahogany are still imperfectly known. Some of these other woods in their structure bear little more than a general resemblance to true mahogany, though skillful finishing may make them very much like it in outward appearance. The majority of them can be distinguished from

true mahogany by the aid of an ordinary hand lens, although in exceptional cases a high-power microscope is necessary. Most consumers of mahogany attempt to distinguish the wood by its general appearance, grain, weight, and color. Such tests, however, can not

FIG. 1.—Range of true mahogany (shown by shaded areas).

be relied upon in all cases and are trustworthy only for those who have for a long time worked or otherwise handled the woods.

Perhaps half the lumber now sold and used as mahogany is not true mahogany, the available supply of which is insufficient to meet the large demand for mahogany furniture, interior finish, and the like. During the year ending June 30, 1914, the total value of true

mahogany and other woods called mahogany shipped into the United States amounted to approximately $5,000,000. They may be divided into two classes, according as they are used for (1) construction and interior finish or (2) furniture and cabinet and other ornamental work. To the first class (used also largely for office and bank fixtures) belong some grades of true mahogany, chiefly from the lowlands of Mexico and wanting figure and luster, and other "mahogany" woods that have very little figure. The second group is made up of the best grades of true mahogany and the more highly figured and ornamental of the other "mahoganies."

The present bulletin confines itself to a discussion of true mahogany.

COMMON NAMES.

Besides its most common name, mahogany, the wood of the two species of *Swietenia* has received a number of other names either locally or in the market. Some of these indicate the place or region where the wood is cut, or the port from which it is shipped. Thus, Tabasco, a State in Mexico, supplies the so-called Tabasco mahogany, as distinguished, for example, from San Jago mahogany, which comes from San Jago, Cuba. Similarly, mahogany from Jamaica, Cispata, Cuba, Honduras, Nicaragua, Panama, Spanish America, Colombia,[1] Mexico, Nassau, Santo Domingo, Haiti, Yucatan, West Indies, South America, Belize, Trupillo, Guatemala, Porto Plata, Laguna, Corinto, and Central America bears as a distinctive part of its local or trade name that of the town, port, State, or region from which the wood is derived. In reference to the excellence or inferiority of the wood from different regions, Santo Domingo mahogany, for example, is considered the most desirable grade. This comes mainly from slow-growing trees on high, dry ground and is relatively hard compared with the soft, spongy "bay mahogany" (*Swietenia macrophylla*) obtained from rapid-growing trees in the moist soil of British Honduras and along the coast of southern Mexico. "Baywood" is another trade name used for the wood from the Mexican lowlands.

The following additional trade, local, and foreign names are also applied to true mahogany:

Caoba[2] or caobo (Spanish name in Cuba, Mexico, Central and South America).

Mahagoniholz or acajouholz (German).

Pao magno (Portuguese).

Albero di acajou (Italian).

Madeira or madeira wood (Florida and Bahamas).

[1] There is also a wood marketed under the name "Colombian mahogany" which is not true mahogany. See Forest Service Circular 185, Colombian Mahogany.

[2] In Costa Rica, Caoba, a name probably of Indian origin, is applied also to *Guarea caoba* C. D. C. and *Carapa guianensis* Aubl.

Redwood (now a rare trade name).

Zipilote colorado and zipilote negro (interior of Mexico).

Acajou, acajou a meubles, bois d'acajou, and mahagon (French in Venezuela and West Indies).

Cedro cebolla (Colombia, S. A.).

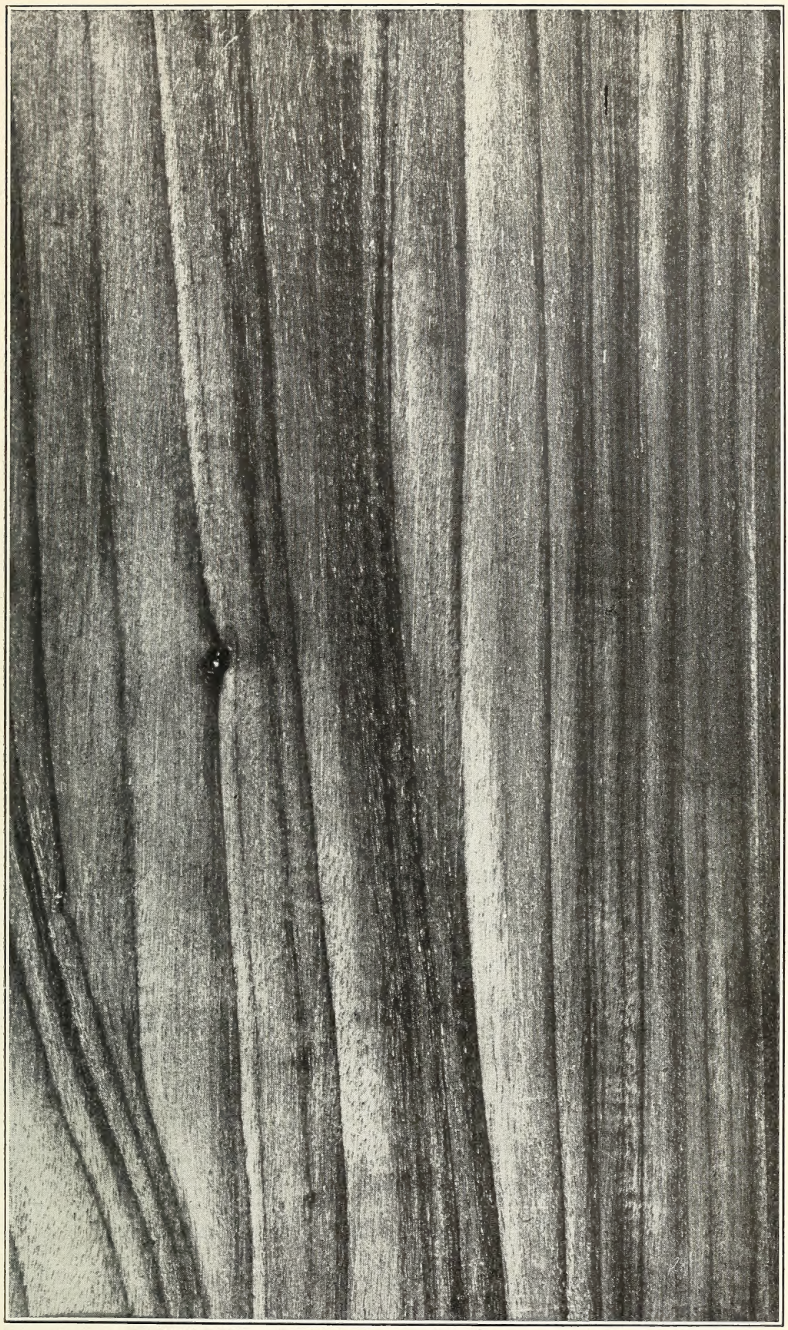
GEOGRAPHICAL DISTRIBUTION.

At one time mahogany was believed to be a native only of the region extending approximately from the northern boundary of Costa Rica northward to Tampico in Mexico. It is now known, however, to extend from the extreme southern point of Florida to the West India Islands, and along the Gulf coast in Mexico from Tampico southward through Central America and into South America. (See fig. 1.) Formerly it was very plentiful on the Island of Trinidad and along the coast of the mainland to Venezuela. It is common in northeastern Colombia and Venezuela. In general, the small-leafed species (*Swietenia mahagoni*) is found in Florida, the West Indies, Central and South America, and elevated parts of Mexico. It is common at elevations of from 3,000 to 4,000 feet, where it grows slowly but produces wood of the best quality. The commercial distribution of the large-leafed species (*Swietenia macrophylla*) is not so well known, but it seems to be most abundant in British Honduras and along the coastal plains of southern Mexico.

From 100 to 150 years are required for a mahogany tree to reach merchantable size. It grows both on high dry ground and in low moist situations. It is on the latter sites, in Mexico and Central America, that the largest timber is produced.

Both species have been planted experimentally in India, Burma, Africa, and other tropical countries, first being introduced at the Calcutta Botanic Garden toward the close of the eighteenth century. Since 1865 its artificial extension over India, Burma, Andaman, and parts of east and west Africa has been fairly rapid. The large-leafed species has been introduced into the Philippine Islands, where it grows very rapidly, but the wood is soft and of an inferior quality.

Provisions are made in several Central and South American countries within the natural range of mahogany to insure continuance of the supply by requiring those who have timber concessions to plant two mahogany trees for every mature one cut. This, however, has been found not only unprofitable, but unnecessary, since natural reproduction on cut-over lands is usually good. At least one large timber company operating in the Republic of Colombia has for over 20 years faithfully carried out the terms of its contract by replanting cut-over areas, but the results are not encouraging. Planted trees often grow very slowly in comparison with those resulting from natural seeding.



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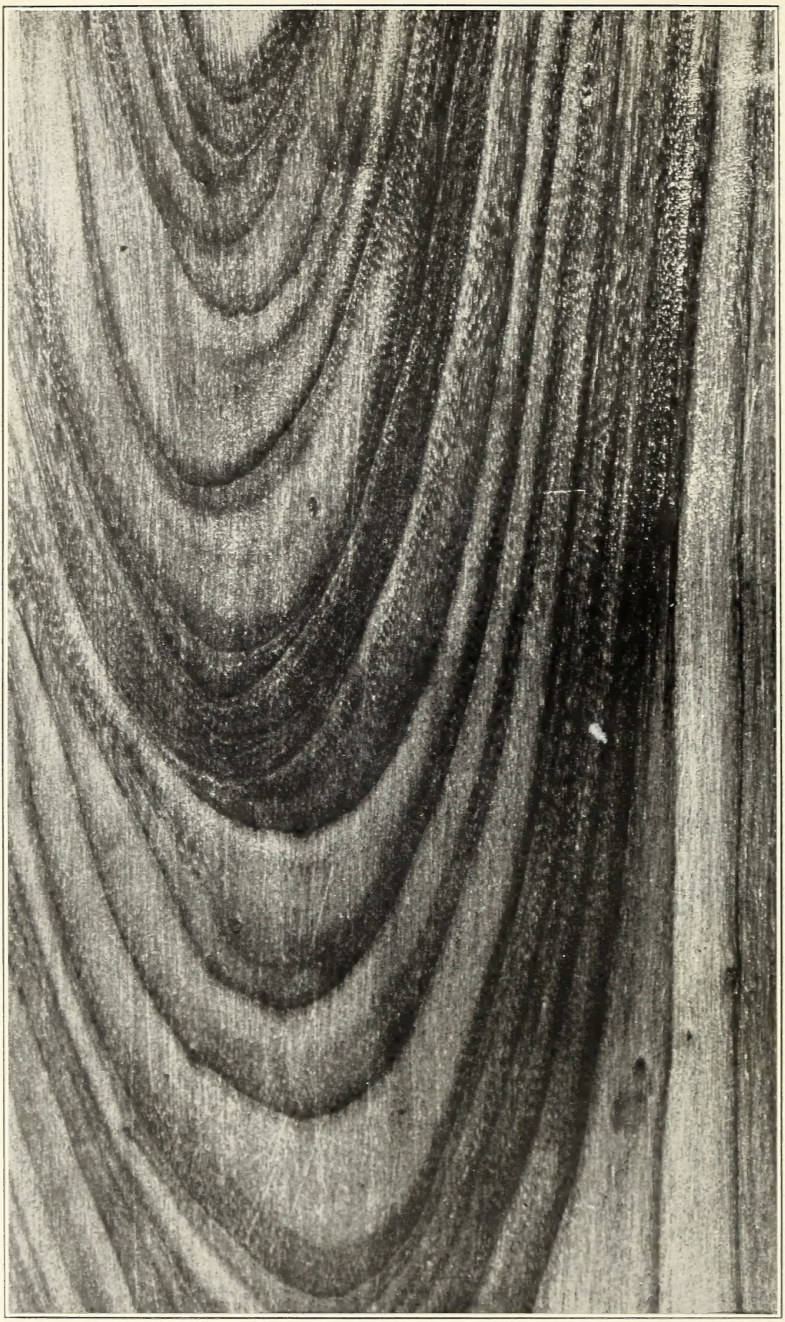
VENEER SHOWING ALTERNATING STREAKS OF LIGHT AND DARK SHADES.



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VENEER SHOWING ALTERNATING STREAKS OF LIGHT AND DARK SHADES.

It is probable that the cultivation of mahogany will never attain commercial importance outside of the tree's original habitat. While it will grow under widely varying conditions of soil and moisture, it seems to do best within the comparatively narrow limits of its natural range. Moreover, the relatively slow growth of *Swietenia mahagoni*, which produces the better wood of the two, is an added handicap. In India, it is true, where conditions are exceptionally favorable, the trees of both species often grow very rapidly, but it is not believed that the planting of mahogany on a commercial scale in India would be a profitable undertaking. Both species are planted extensively as shade trees throughout tropical America. The large-leafed species produces a very dense crown and is regarded as one of the best shade trees; the small-leafed species has an open crown and, like the famous saman tree (*Pithecolobium saman*) of Central and South America, forms a splendid tree for the lawn or park where dense shade is not desirable.

GENERAL CHARACTERISTICS OF THE WOOD.

Mahogany is moderately strong and tough, quite uniform in structure, and may be either moderately open grained or close grained, depending largely on the locality where grown. The wood seasons with comparatively little warping and checking, and once seasoned shrinks and swells very little. This property of holding its shape, together with its handsome grain and figure, makes it one of the most satisfactory cabinet woods and causes shipbuilders to prize it. It takes a beautiful natural-wood polish, is well adapted to stains, and has the particularly valuable quality of taking glue well. The wood is also being used now to some extent for pattern work. Owing to the small size of the pith rays, quarter sawing adds little to its figure. The grain of high-grade mahogany is often very odd and pronounced, and in this form it is the most valuable cabinet wood known. For the most part it is cut into very thin veneer by a special machine to avoid waste. Veneer of great beauty is obtained from crotched pieces which are taken from the tops of trees where the limbs join the trunks. This form is known on the market as "crotch mahogany."

Mahogany is one of the most popular furniture woods, chiefly because of its lasting qualities, color, and grain, and its freedom from warping, shrinking, and checking. Of all the cabinet woods now on the market, however, mahogany shows the greatest variation in quality. Even woods from the same locality do not grade alike. Beauty of grain is the chief property by which mahogany is graded, though closely allied to this is figure or pattern. (Plates I and II.) Size is also a factor in determining the value of mahogany lumber.

The numerous trade names given to mahogany usually imply a difference in grade, as determined by the features just pointed out. Formerly mahogany from Nassau or Santo Domingo was distinguished from Cuban mahogany by the smaller size of the logs, and dealers still carefully discriminate between so-called Spanish or Cuban mahogany and that obtained from other islands of the West Indies. The large trees accessible in Cuba, however, have practically all been cut.

Florida, Cuba, Mexico, and Honduras exhibit distinct features of soil and climate and produce grades of mahogany of characteristic qualities. The difference between woods from the various regions is often so marked that an expert can tell at a glance from which one of them a given piece of wood has come. Trees on the hard, dry limestone soil of extreme southern Florida grow very slowly and produce a wood that is hard, heavy, dark red, and beautifully figured. This mahogany takes a better and more lasting polish than any other grade of the wood. The mahogany of Cuba and Santo Domingo grows in a richer, moister soil, and, as a result, is usually somewhat softer and of lighter weight than Florida mahogany, but nevertheless is of a high grade. It has a close, even grain, and the logs imported seldom average more than 10 cubic feet each. Some of the pores are filled with hard, gritty, white masses which constitute a distinguishing character. Mahogany from those parts of Mexico and British Honduras where soil and climatic conditions are very favorable to rapid plant growth is considerably lighter in weight and often much lighter in color than that from more elevated regions. Mexico produces larger mahogany trees and a greater yield per acre than any other country. Honduras produces logs 40 feet long and 4 feet in diameter. The wood is a beautiful dark color with a more or less wavy figure. Even 6-foot pieces with a wavy grain and including crotches of the trees sometimes bring fabulous prices. Occasionally single logs have been sold for $3.000. The claim that Mexican mahogany is generally of a much better grade than that from Central America is not true of the grade of Mexican mahogany known as baywood (*Swietenia macrophylla*), which usually sells for much less than the ordinary heavier, darker colored mahogany from regions farther north, which is the small-leafed mahogany (*Swietenia mahagoni*). The dark reddish-colored grades of Mexican mahogany, however, are fully equal and in some instances superior to the Central American wood.

The weight of mahogany varies greatly according to the density of the wood. Florida mahogany is the heaviest, having a specific gravity when dry of 0.842. A cubic foot of it weighs 52½ pounds, and 456 board feet weigh a ton. The better grades from Honduras and Mexico have a specific gravity of about 0.74, 1 cubic foot

weighing approximately 46 pounds, and 520 board feet a ton. The average mahogany wood from Cuba has a specific gravity of about 0.72, and a weight per cubic foot of about 45 pounds, 533 board feet weighing a ton. The lightest mahogany wood is the baywood, from Mexico, which has a specific gravity of 0.561. A cubic foot weighs only about 35 pounds, and about 686 board feet are required to make a ton.

The pale-yellow or whitish sapwood of mahogany is thick in young and in rapid-growing trees and thin in old and in slow-growing ones. In Florida the sap is often less than 1 inch in thickness on the largest trees, with about 25 annual rings of growth. Compared with this, the sapwood of large trees from Mexico and Honduras is often more than four times as thick and contains less than one-half as many rings of growth. The structural characters of the sapwood and heartwood of mahogany are, of course, similar, but the sapwood is almost never used and is generally removed before the logs are shipped to market. If it is not removed immediately after the trees are felled it is apt to become affected by fungi which may also damage the heartwood.

The color of heartwood ranges from a rich light brown to a dark red-brown, the shade becoming deeper with age and exposure. Florida mahogany is the darkest colored, Cuban and Honduras wood come next, and the baywood grade of Mexican mahogany is the lightest colored. These marked differences in color, as also in density and weight, appear to depend entirely upon the rate of growth, which, in turn, is dependent upon soil and climatic conditions.

CHARACTERISTICS OF THE WOOD FROM DIFFERENT REGIONS.

When mahogany comes into the market it is graded without reference to whether it is the wood of the small-leafed or large-leafed species. Timber merchants and wood users are interested primarily in the origin of the wood, which affords them a clue as to its quality.

Mahogany from Florida is the hardest and heaviest of all the West Indian grades. The wood has very narrow annual rings of growth, and the pores are very small, often not more than 0.1 of a millimeter in diameter. The pith rays are broad and quite clearly defined, thus contrasting strongly with Mexican mahogany from the coastal plains, which has pores from two to three times as large, and the pith rays narrower and less numerous.

Cuban mahogany is hard, heavy, and slightly darker in color than that of British Honduras. The annual rings of growth are very narrow, especially in trees grown on the higher elevations. The pores,

which are usually filled with a white substance known as tylosis, are considerably smaller (0.15 millimeter) than the wood from British Honduras, and the pith rays are quite clearly visible to the unaided eye. Cuban mahogany is usually from old, knotty, and decrepit trees grown in high rocky uplands. At present very large logs are rare. The smaller ones now cut are of good quality as far as the character of the wood is concerned and are used chiefly for sliced veneer.

San Salvador mahogany is similar in color, hardness, and weight to that of Venezuela. The annual rings of growth are somewhat less clearly defined and wider than in mahogany produced farther south. The pores are prominent (about 0.2 millimeter in diameter), and the pith rays quite conspicuous, often producing a beautiful effect in radially cut boards. At one time a good deal of mahogany from San Salvador was shipped to England under the name of "Nicaragua wood," and to this country as "Cispata mahogany."

Mahogany from Venezuela is hard, heavy, and dark brown, with a golden tinge, particularly noticeable on the radial surface. The annual rings of growth are more or less prominent, unequal in width, but usually rather wide. The pores are large and visible to the naked eye. The pith rays are numerous and scarcely visible on a smooth transverse section. This wood works well and is exported chiefly to France for fine furniture and interior finish.

Mexican mahogany is the most variable in quality. Although a good deal of the wood from the higher elevations of Mexico superficially resembles that from Cuba, it is on the whole softer and lighter in color, even resembling the wood of the famous Spanish cedar so much used for cigar boxes. The best Mexican mahogany comes from the interior and higher portions of the State of Tabasco, and in size, color, and hardness is superior to the best product obtained in the lowlands farther south. Mexican mahogany has slightly larger pores than the wood from Cuba, and the pith rays are not visible except under a pocket magnifier.

Mahogany from British Honduras contrasts strongly in appearance and in structure with that from other regions. Annual rings of growth are often wanting, so that the wood has a nearly homogeneous structure. It is moderately soft and light in weight, but in quality and color compares favorably with that from Venezuela. The pores are large, often from 0.2 to 0.25 millimeter in diameter, and are usually filled with a dark-brown substance known as tylosis. Pith rays are very narrow and indistinct. Wood from this region is straight grained, usually free from knots, and easily recognized. It is well adapted for inside work where figure is not required.

MARKET VALUE.

The best grades of mahogany sell in New York for from $175 to $200 per thousand board feet, while the average run of firsts and seconds brings about $150.

Specially well-figured Cuban mahogany, suitable for fancy counter tops, and selling for from $300 to $400 per thousand, is now very scarce. Culls sell for from $60 to $100 per thousand board feet, and commons for from $100 to $150. A poor grade of Cuban short stock often sells for $60, and sometimes as low as $50, per thousand. The best grades are used for fancy furniture and interior finish; the larger logs with desirable figure, which bring from $100 to $150 per thousand board feet scaled, are converted chiefly into veneer. The San Jago mahogany, which comes from San Jago, Cuba, sells for from $140 to $165 per thousand. The supply of Cuban mahogany is gradually diminishing. Two grades of Mexican mahogany, alike in their pale color and straight grain, but differing in their hardness, do not finish well and do not improve in color with age. The softer of these, sometimes called "sappy mahogany," sells as low as $20 or $25 per thousand. The other grade has few defects and is used for patterns.

USES AND SUPPLY.

The earliest recorded use of mahogany was between 1521 and 1540, when Spanish explorers employed the wood for making canoes and for ship-repair work. Mahogany was again used in 1597 in repairing Sir Walter Raleigh's ships in the West Indies. At this time the wood was called Cedrela, the name applied later to the Spanish, or cigar-box, cedar (*Cedrela odorata* L.). The first use of true mahogany for cabinet work was in 1724 in England. It was probably the first wood of the Western Continent to attract the attention of European timber dealers. Some idea of the enormous consumption of mahogany in England alone may be had from the fact that as early as 1846, when the wood was still valued chiefly for shipbuilding, approximately 85,000,000 board feet were shipped to English ports. Since then the amount has diminished considerably, partly because of gradual exhaustion of the more accessible timber and partly, also, because of the introduction of substitutes.

Its first use in England and Spain was for shipbuilding, and during the eighteenth century it was the chief wood employed in Europe for this purpose. It is particularly suited for planking, waterways, bulwarks, rails, skylights and companions, bitts, gangway ladders, and other deck work. With the later employment of iron, steel, and teak in shipbuilding, mahogany became more important as a furniture wood, though it is still preferred to any other wood for the

framework of small sailing vessels. Large sailing vessels with mahogany framework were sold for enormous prices and manufactured into fine furniture. The outer planking of American yachts is preferably of mahogany, although teak is still used for this purpose. The principal use of mahogany is for high-class furniture; it is also much used for the interior finish of parlor cars, public buildings, hotels, and dwellings, and for office fixtures. It is used very extensively for pianofortes, for astronomical and surveying instruments, and for the cases of all sorts of delicate apparatus, such as scales, microscopes, and microtomes. The present extensive use of mahogany for the interior finish of fine office buildings, particularly in this country, has created a demand for specially large-dimension boards, obtained from logs which come from Mexico and British Honduras.

As early as 1850 English timber merchants feared an exhaustion of the world's supply of West Indian mahogany, then the best-known and most highly prized of the different grades of woods. As a result, timber prospectors began to search for other woods that could be substituted, and after the British conquest of India a number of different woods resembling mahogany were shipped from that country to England. So far as is now known the introduction of these woods marked the beginning of the substitution of mahogany-like woods for true mahogany. African "mahogany" was first imported into England in 1833, when 58 logs were sold in Liverpool, but it was not until about 1878 that it became commercially important. African "mahoganies" are now among the leading fancy cabinet woods in England and also have an important place in the principal American markets.

Immediately after the acquisition of the Philippine Islands by the United States several other woods entirely unrelated to true mahogany began to be exploited and sold under the name of "Philippine mahogany." A good deal of this material has been shipped into the United States during the last decade, and the importations have been rapidly increasing.

Millions of feet of true mahogany are still available, however, in remote places difficult of access. No one knows just how much standing mahogany is left, though vast areas are believed to exist in Mexico and Central America.

The early impression that the supply of mahogany was nearing exhaustion came from the practice of cutting only the easily accessible trees along and near waterways. Wood drawn from the tropical forests for nearly 200 years has been obtained mainly from territory bordering water courses, while that farther inland remains untouched. The mountain forests of Cuba still contain a large supply of the finest mahogany, but it would cost more to transport the logs to shipping points than they would bring in the market. The supply of Santo

Domingo mahogany within easy reach of water is now almost entirely exhausted, and the logs coming from there, as well as from Cuba, are from lands already cut over. In consequence, they are small, crooked, and often of low grade.

The best available mahogany timber lands of the American tropics and subtropics are now largely controlled by American and English concessionaires who, a number of years ago, when the price of mahogany was lower than at present, foresaw its future value and obtained options on large tracts. Now it is almost impossible to obtain a workable concession of mahogany timber at a price low enough to permit lumbering at a profit.

Mexico, Cuba, Central America, and South America are the chief producers of mahogany, other regions within the range of the tree contributing comparatively small quantities. British Honduras and Mexico each supply nearly one-third of the total imports of true mahogany. (See Table II.)

English timber merchants have been exploiting mahogany in British Honduras for many years, and at present several American companies are also operating there. All these companies have their shipping point at Belize, to which logs are towed principally down the Hondo River.

The State of Tabasco yields the greater part of the mahogany from Mexico. The principal points in Mexico from which mahogany is exported are: Tecolutia, Frontera, Cazones, Laguna, Santa Ana, Tuxpan, Tampico, Chiltepec, Campeche, Coatzacoalcos, Minatitlan, Nautla, Tonala, Cheucan, and Tlacotalpan.

Mahogany has been exported from Tabasco for a number of years because the seacoast of the State has numerous bays and harbors which are safe for large vessels at all seasons. Into these bays run many large rivers, chief among them the Usumacinta, Iryobva, and Tancockapa. The Usumacinta River is about 400 miles long, forming a part of the boundary between Guatemala and Mexico, and is navigable for nearly 240 miles above its mouth. The country all along the river abounds in mahogany, and large quantities are cut annually, brought to the river, and towed down to the landing points. At present five American companies are operating within the State of Tabasco, one of which is said to ship annually 5,000 tons, or approximately 2,500,000 board feet of mahogany.

While very desirable mahogany comes from the other tropical American countries, their production is considerably less. Some of the finest mahogany comes from southern Florida and the adjacent keys. On the keys the wood is called madeira,[1] and is commonly thought not to be mahogany, but a different and much better wood.

[1] Not to be confused with *Tamarindus indica* L., the wood of which is sometimes known as "madeira."

On the island of Andros (Bahamas) it is often used for board walks and other purposes requiring durability. Mahogany grows on most of the West India Islands. In the early days of railroad and bridge building there and in Central America the lasting qualities of mahogany made it a favorite wood for railroad ties and bridge timbers, which greatly reduced the supply.

IMPORTATIONS.

Previous to 1892 there is no complete record of the quantity of mahogany shipped to the United States, nor even of the countries from which mahogany was imported. Since that year, however, a record has been kept by one of the large importers[1] of the mahogany entering New York from the chief centers of production. The following table gives the quantities imported since 1892 from each of these regions:

TABLE I.—*Shipments of true mahogany entering New York from 1892 to 1910, inclusive.*

Year.	Cuba.	Mexico.	Central and South America.	Total.
	Thousand feet.	*Thousand feet.*	*Thousand feet.*	*Thousand feet.*
1892	3,884	7,871	.....	11,755
1893	5,960	10,941	.....	16,901
1894	1,506	3,909	.....	5,415
1895	2,549	5,818	.....	8,366
1896	451	6,794	.....	7,244
1897	94	6,202	1,756	8,053
1898	92	9,396	6,541	16,034
1899	689	11,477	8,985	21,150
1900	3,615	9,557	4,186	17,357
1901	3,822	7,877	3,302	15,000
1902	6,043	6,940	3,407	16,390
1903	4,742	9,145	3,580	17,466
1904	1,564	7,043	2,842	11,448
1905	1,829	3,195	2,615	7,638
1906	3,883	4,164	1,563	9,609
1907	3,458	8,387	3,304	15,149
1908	1,796	5,205	2,597	9,598
1909	3,037	3,452	11,557	18,046
1910	2,576	7,983	2,128	12,686

The logs imported from Central and South America from 1892 to 1896, inclusive, are included with those quoted from Mexico. Fluctuations in the amounts of mahogany imported into this country from one year to another can not be attributed to any particular cause. Imports of 1894 to 1897, inclusive, were all low, averaging a little less than 7,750,000 feet annually. During the seven years which followed the annual importations averaged approximately 16,000,000 feet, in the banner year (1899) amounting to 21,149,750 feet.

Since 1892 Mexico has shipped to the port of New York upward of 136,000,000 feet of true mahogany, while since 1897 Central and

[1] Mr. Geo. F. Herriman, New York City.

South America have shipped about 50,000,000 feet. Although Cuba ships to this country more logs than either Mexico or Central and South America the number of board feet is much below that of Mexico, being approximately only 52,000,000 feet during the last 19 years. The other main ports of entry for true mahogany are Boston and New Orleans.

It is practically impossible to ascertain just what proportion of the wood entering these ports as mahogany is true mahogany. A fair approximation has been reached, however, by grouping[1] together the imports from countries within the range of true mahogany and those outside of its natural range. The following table shows these approximations:

TABLE II.—*Quantity and value of true mahogany and other woods imported as mahogany (unsawed) from different countries during the fiscal year ending June 30, 1914.*[2]

Country.	True mahogany.		Other "mahogany" woods.	
	Quantity.	Value.	Quantity.	Value.
	M feet.		*M feet.*	
British Honduras	11,074	$781,838		
Africa			[3] 32,441	[4] $2,377,502
Colombia	13	746		
Cuba	2,988	193,692		
Guatemala	718	43,701		
Honduras	6,591	368,431		
Mexico	10,381	785,148		
Nicaragua	4,933	290,502		
Panama	28	1,321		
Santo Domingo	537	34,589		
Philippine Islands			717	44,552
Other countries	44	2,807	5	297
Total	37,307	2,502,775	33,163	2,422,351

Table II shows that about 4,000,000 feet more of true mahogany was imported by the United States than of the other "mahoganies" during the fiscal year ending June 30, 1914. It is probable that some of the mahogany reported from the different mahogany-producing countries is not true mahogany; it is also probable that a considerable quantity of wood which is not true mahogany and is marketed in this country as mahogany is imported under some other name. The total quantity of true mahogany is, therefore, probably less than that of the other woods.[5] The bulk of true mahogany,

[1] Data for this purpose were derived from the Department of Commerce.

[2] More recent statistics not given on account of abnormal trade conditions.

[3] Only 13,423,000 feet were imported directly from Africa. The remainder constitute reshipments from England, Germany, and France.

[4] English shippers include insurance and freight in their statement of export values, which accounts for the comparatively high cost per thousand board feet.

[5] A good deal of sabicu (*Lysiloma sabicu* Benth.) and Spanish cedar (*Cedrela odorata* L.) is shipped from Cuba as mahogany. Colombia exports the Colombian mahogany (*Cariniana pyriformis* Miers.), which is not the true mahogany. Honduras, Guatemala, and Mexico export nispero (*Achras sapota* L.) and Spanish cedar as mahogany.

as will be seen, comes from British Honduras and Mexico, which together furnished 58 per cent. Santo Domingo, Panama, Nicaragua, Honduras, Guatemala, and Colombia furnished 34 per cent, and Cuba 8 per cent.

While the actual quantities of true mahogany and other "mahoganies" imported into the United States by different countries can not be ascertained, Great Britain is known to be first as a source of the latter, which come chiefly from Africa and reach the American markets by reshipment from London and Liverpool. Of the total amount of true mahogany and other "mahoganies" imported, Great Britain supplied 18,289,000 feet, or 26 per cent (by reshipment from points of origin), and Africa furnished 13,423,000 feet, or about 19 per cent, through direct shipment. Table III shows the quantities and value of mahogany (true and other) imported by the United States from 1901 to 1914.[1]

TABLE III.—*Quantity and value of true mahogany and other mahoganies (unsawed) imported by the United States from 9101 to 1914.*[2]

Year.	Quantity.	Value.
	Thousand feet.	
1901	32,281	$1,752,612
1902	44,795	2,361,483
1903	48,387	2,783,679
1904	50,370	2,690,382
1905	31,844	1,977,894
1906	36,619	2,470,072
1907	51,899	3,263,718
1908	41,678	2,566,594
1909	39,828	2,479,976
1910	44,524	3,224,152
1911	43,914	3,171,398
1912	43,194	3,038,043
1913	66,318	4,839,625
1914	70,470	4,925,126

METHODS OF LOGGING AND TRANSPORTATION.

Formerly all logs were squared by hewing, usually in the forest. The purpose of this was partly to show the figure of the wood, but mainly to remove the useless sapwood. Few trees are cut in Mexico and Honduras that will not square 18 inches or over. The removal of the worthless sapwood by squaring the logs resulted in a very great waste of the best heartwood, particularly near the butt ends, the most valuable part of the logs. Since there is no duty at present on cabinet woods, and transportation is comparatively cheap, a relatively large saving of valuable wood can be effected by shipping mahogany logs in the round. Much of the sapwood may, of course, be cut away before shipment, but under present methods of handling even this added expense seems useless. Another marked waste by

[1] Data for this purpose were derived from the Department of Commerce.
[2] Fiscal years ending June 30.

past methods of lumbering was in the practice of leaving high stumps. With a large tree the stump is one of the most valuable parts, but it is seldom utilized. The trunks of mahogany trees are disproportionately large at the bases, and native laborers in the Tropics cut the stumps high to avoid the extra work of chopping through the enlarged buttress, or "spurs" which spread out and form massive triangular braces often extending from 8 to 10 feet beyond the main axis of the trunk (Pl. III). The trunks are so tapering that if a tree is cut above this basal swelling from 200 to 500 board feet of the choicest wood may be left in a single stump. The spurs themselves also contain uniquely figured wood which would doubtless command fancy prices. Needless waste of this sort is being eliminated in the case of far less valuable trees than mahogany.

Operators now exploiting mahogany in Mexican and Central American forests have pretty generally abandoned the primitive methods of felling, hauling, rafting, or loosely floating the timber to shipping ports. Instead of snaking or hauling logs to river banks with oxen and clumsy conveyances, up-to-date methods of transportation are now usually employed. There is also a better systematizing of the work. While felling is in progress men are building railroads and bridges over which carloads of logs are hauled to the port, where the timber is placed on steamers for final shipment. Even carrying logs by rail to inland waterways, where they are turned adrift and floated down to the ships at tidewater, is done less frequently now, because the logs are so bruised and splintered by striking rocks in their transit down the river that they have to be hewed and sawed off at the ends to remove the battered, useless wood.

BOTANICAL CHARACTERISTICS.

The mahogany trees (*Swietenia mahagoni* Jacq.)[1] and (*Swietenia macrophylla* King.)[2] are among the most majestic and beautiful evergreen trees of tropical America. They are members of the family *Meliaceae*, to which belongs the closely related and well-known China tree (*Melia azedarach* L.), extensively planted for shade in the Southern States. In favorable locations mahogany at-

[1] Jacquin, who described this tree in 1760, named it in honor of the celebrated Baron von Swieten, physician to Maria Theresa, Empress of Germany. The specific name *mahagoni* is derived from the original French name *mahagon*. Botanists follow the original spelling of the word *mahagoni*, while the Anglicized name is spelled *mahogany*.

[2] The mahogany of British Honduras and coastal plains of Mexico is a distinct species. Zuccarini (in Abh. Akad. Muench. II (1831–1836) 355, L. T.–Mexico) described another species, *Swietenia humilis*, which is regarded by the Mexicans as distinct from the other two kinds. It is called gateado (Conzatti, C.–Flora sinoptica Mexicana. Oaxaca. 1897), or flor de venadillo, to distinguish it from the larger tree (*Swietenia mahagoni* Jacq.), which goes under the name of caoba, rosadillo, tozopilotlzontecomatl, tzopilotlzonecomatl, zopipoquahuitl, zopilote, or zopilotl. Two other kinds, commonly known as zopilote colorado or zopilote negro, are recognized by Mexicans, but these are not described botanically and can not now be regarded as distinct forms.

tains large dimensions, some trees measuring 4 to 6 feet in diameter just above the enormous root swelling (Pl. III), with a height of from 80 to 100 feet. Exceptional trees are known to have reached a diameter of 12 feet. Trunks are frequently clear of branches for from 40 to 50 feet, above which is a broad oval-shaped crown. The pinnately compound leaves are made up of oval lance-shaped leaflets (fig. 2, *a*), which are light green in color, smooth and shining above, and slightly brownish on the under surface. The small whitish or purplish flowers (fig. 2, *b* and *c*) are borne during July and August, and by October or November the large dark-brown seed pods (fig. 3) are ripe. The latter are from 1 to 2 inches in diameter and from 3 to 6 inches long. The trees of these two species can be readily distinguished. *Swietenia mahagoni* has rather small leaves, an open crown, and the pods are seldom over 3 inches long; *Swietenia macrophylla* has larger leaves, a dense crown, and the fruit pods are from 3 to 6 inches long.

The commercial distinctions made in mahogany from different regions have a basis in the gross and minute structure of the wood. Regions of like climatic and soil conditions as a rule produce mahogany of similar or nearly similar structural characteristics and qualities. In the matter of weight and hardness, however, there are occasional exceptions to this general rule. As already pointed out, Florida mahogany is almost invariably harder and heavier than that from Cuba or Mexico. Individual trees from Cuba or Mexico, however, may yield very much harder and heavier wood than the average grades from Florida. Weight and hardness therefore are not invariable means of distinguishing mahogany from different regions. The chief constant difference in the mahogany of the various regions lies in the presence or absence of the annual rings of growth, in their width, and in the character of the pith rays.

True annual rings are not formed regularly in the wood of mahogany farther south than British Honduras, owing to the fact that growth continues practically throughout the year. Mahogany wood produced north of British Honduras commonly shows in transverse sections more or less distinct annual rings of growth. These rings are made prominent, not as in ring-porous hardwoods of the Temperate Zone, by rows of large pores in that part of the ring formed in the beginning of the growing season, but by an abrupt reduction of the radial diameter of the outer rows of wood fibers formed at the end of the growing season, as well as by several rows of large wood fibers, tracheids, and wood-parenchyma fibers formed in the next succeeding layer. This narrow line of demarcation can be seen readily with the unaided eye on a smooth transverse section. However, marks resembling the limits of annual growth do not indicate

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TRUNKS OF TWO TYPICAL TREES, SHOWING BUTTRESSES.

FIG. 2.—*Swietenia mahagoni: a,* Stem and leaf, natural size; *b,* flowering branch, natural size; *c,* flower, twice natural size.

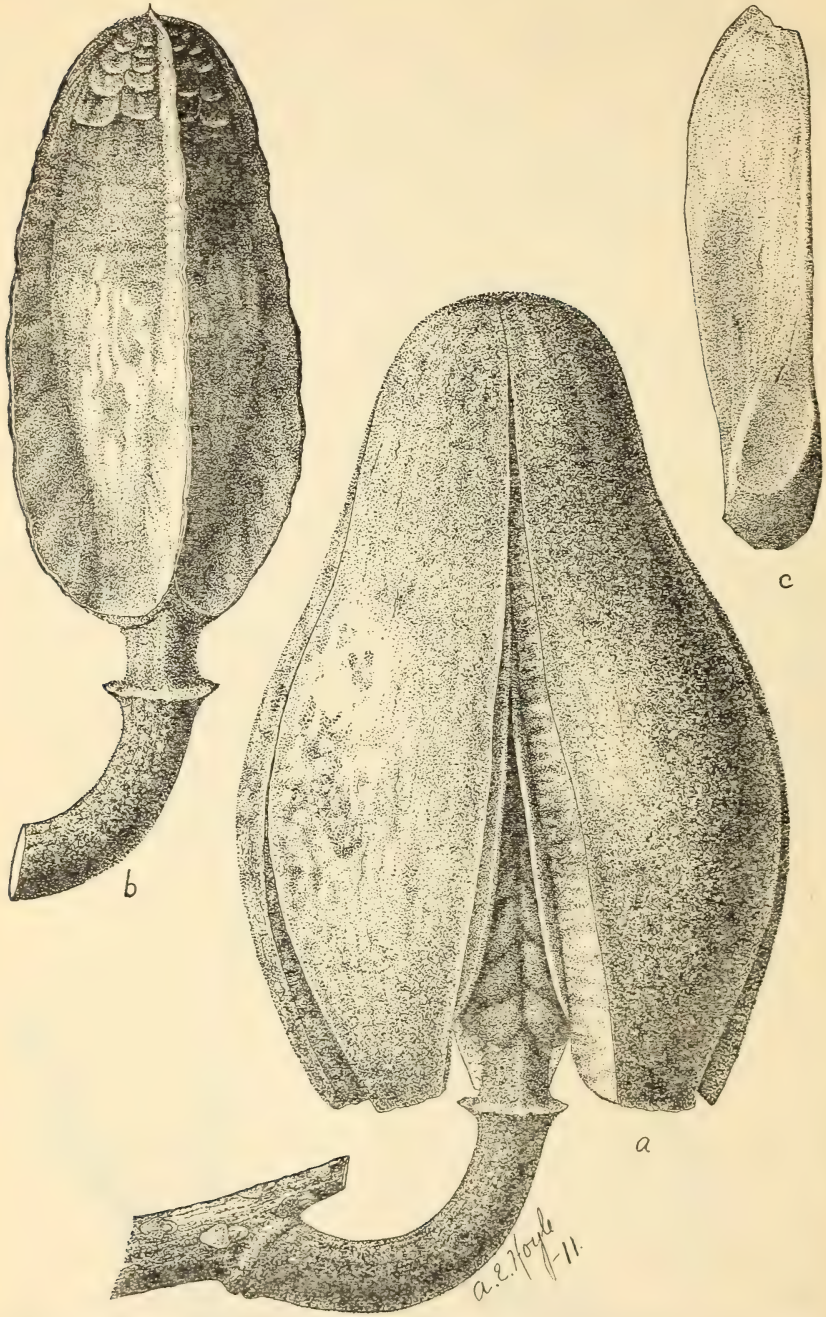

FIG. 3.—*Swietenia mahagoni: a*, A fruit; *b*, the axis of fruit, showing place of attachment of seeds at apex; *c*, winged seed. Two-thirds natural size.

the actual quantity of wood laid on during one year, but that of a much shorter or longer period. They may be due to drought, to defoliation, or to excessive heat or cold which interrupts growth activity for a short time. From this region northward the tree forms more and more distinct and at the same time much narrower annual rings of growth. The growth therefore is very slow, the vessels or water carriers are small, the wood fibers also are small and thick-walled, and as a result the wood is very heavy and hard.

Mahogany wood is diffuse porous; that is, the pores are distributed more or less uniformly throughout the wood. They usually occur singly, but may occur in radially disposed small groups of from two to four. Most of them are filled with tylosis, usually dark brown or reddish, but sometimes, as in Cuban and some Central American mahogany, white or nearly so.

The pith rays, from one to four cells wide, are the radially disposed rows of cells (parenchyma elements) seen with the unaided eye as faint lines in a smooth transverse section. They frequently have a slightly wavy course and bend around the vessels. In a tangential section they are often arranged in horizontal rows and are known as storied rays.

MINUTE CHARACTERS OF THE WOOD.

The quality and often the source of true mahogany may be determined by its minute structure. The length of the wood fibers varies according to the locality in which the tree grew. This variation in the fiber length is shown in Table IV. Microscopically considered, the wood of mahogany is made up of pores (or vessels), tracheids, wood-parenchyma fibers, wood fibers, and pith-ray cells. The minute characters of these elements are as follows:

Pores[1] in mahogany are rather large, with an average diameter of 0.15 millimeter, and together with accompanying parenchymatous elements often occupy the entire width of the wood ray; that is, the portion lying between two pith rays. The small pores are located near the periphery of the annual ring. These small vessels are composed of segments which often resemble tracheids in form. These segments, which can be seen in longitudinal sections or in macerated material, are from one to three times as long as wide (fig. 4, A). The openings in the horizontal partition walls of the larger vessels are round and simple throughout (fig. 4, A, *c*), while the openings on the smaller vessels are generally oval or elongated and placed obliquely. The vessel walls are furnished with numerous lenticular bordered pits (fig. 4, A, *d*), which occur in vertical rows where the

[1] These elements are known as pores in transverse sections, and as vessels in longitudinal sections.

vessel is in contact with wood-parenchyma fibers, and in horizontal rows where it is in contact with pith rays, often giving the vessel a scalariform (ladder-like) appearance. The majority of vessels contain reddish-brown tyloses. These masses occur at regular inter-

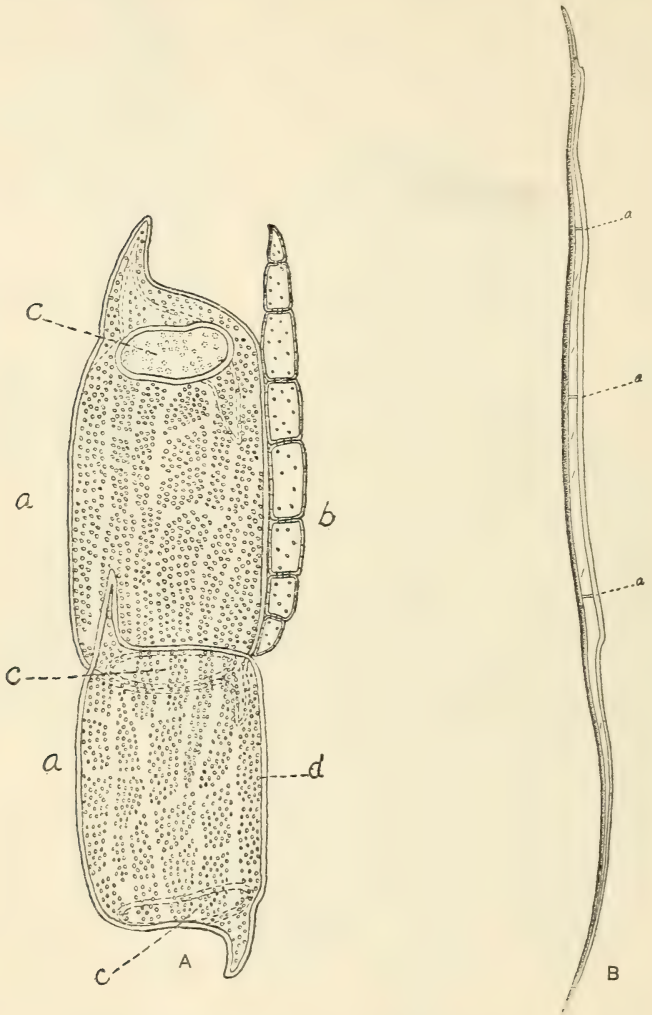

FIG. 4, A.—*a*, *a*, Two segments of a vessel, and *b*, wood-parenchyma fiber, both separated from the wood of *Swietenia mahagoni*; *c*, shows complete absorption of the partition walls of each vessel segment; *d*, small bordered pits. Magnified about 100 diameters.
FIG. 4, B.—Wood fiber(separated) of *Swietenia mahagoni*, showing cross-partitions at *a*. Magnified about 100 diameters.

vals (longitudinal section), and often appear as minute partition walls within the vessels. They stain very readily with hæmatoxylin and dissolve under the action of Schultze's maceration mixture and

potassium and sodium hydroxides. The wood when boiled in a weak solution of the hydroxides yields a deep reddish-brown coloring matter.

Wood fibers occur usually in distinct radial rows, from a few to 12 or 15, between pith rays, and constitute the bulk of the wood. Near the pores this regular radial arrangement is often disturbed by their rapid growth. They are polygonal and have as a rule small lumina (cell cavities). They vary from 0.84 to 2.268, averaging 1.315 millimeters in length, and are rarely more than 0.02 millimeter in diameter. Wood fibers are often found that have delicate transverse partitions (fig. 4, B), a character that has been frequently observed in other woods belonging to this family of trees. True wood fibers are sometimes mistaken for wood-parenchyma fibers, but they may be distinguished from the latter by the very sharp-pointed ends and the minute, simple, slit-like pits. The fact that the wood fibers in mahogany are septate serves to distinguish true mahogany from a great many of its substitutes.

The cells in the outer part of the annual rings of growth are especially remarkable for their thickness and density. It is also noticeable that the cavities of the wood fibers in the early wood of samples from Florida and Cuba are larger than those formed later in the season. The reason for this appears to be that the fibers with wide cell cavities in the early wood serve as carriers of sap, and there is, therefore, no need of large vessels for this purpose in the late wood. This is evidently not the case in wood from British Honduras. In wood of the latter type, which forms no such large cells in the early wood, there seems to be greater need of large vessels throughout the entire seasonal or annual layer of growth in order to transport the large supply of water these trees require, because there is practically no cessation in vegetative activity throughout the growth period. The distribution of the large vessels is, therefore, regular throughout. In the wood with large vessels the fibers have thinner walls, and the quality of wood may be judged or predicted from such structural characteristics.

Wood-parenchyma fibers (fig. 4, A *b*) occur usually near the vessels and consist of from four to eight slightly elongated, thin-walled cells. In transverse section these cells are polygonal in form; in longitudinal section they are perpendicularly elongated and have small round or oval pits on their radial and tangential walls. Where they are in contact with vessels the pits are larger and not infrequently have a slight border. The individual cells contain an abundance of dense brown coloring matter similar to that found in pith-ray cells. A number of these fibers are made up of cubical cells with very thin walls, each cell being filled with a small crystal of calcium oxalate or calcium carbonate. These crystal-containing fibers are es-

pecially abundant in mahogany grown in dry, rocky soils as, for example, in Florida and Cuba.

Pith rays are from 1 to 4 cells in width, and from a few to 20 or more cells in height. The individual cells of the pith rays are generally rectangular in form and radially elongated, as seen in transverse and radial sections. The upper and lower rows (marginal cells), however, are elongated in the longitudinal direction. These marginal cells have thinner walls and less numerous pits than the other cells of the pith ray. Pith-ray cells have thin walls and possess only round simple pits. The pits, except where they are in contact with vessels, are large and simple, often slightly bordered. They are most numerous in the end walls. All the cells of the pith rays contain an abundance of reddish-brown coloring matter.

To determine the average length of the wood fibers of true mahogany and the effect of different climatic and soil conditions upon their length, samples of mahogany from the six regions were selected for examination under the compound microscope. The material was macerated by means of Schultze's maceration mixture, and the fibers measured. From these data averages were computed.

One hundred fiber measurements were taken from each individual block, and their averages computed, with the results shown in Table IV. The maximum and minimum lengths for each set of blocks are also given.

TABLE IV.—*Length of wood fibers of true mahogany from different localities, in millimeters.*

Source of material.	Average.	Maximum.	Minimum.
Honduras	1.747	2.268	1.218
Venezuela	1.324	1.638	.882
San Salvador	1.271	1.722	.882
Cuba	1.234	1.680	.840
Mexico	1.176	1.470	.882
Florida	1.136	1.428	.840
Average length	1.315		

WOOD CALLED "MAHOGANY."

The following cabinet woods resemble true mahogany in one or more characters, and on this account a good many, if not the majority, are marketed as mahogany of the particular region or country from which they are obtained. Some, however, occasionally come to the market under names of local origin.

FROM INDIA, CEYLON, ANDAMAN, EAST INDIES, AND BORNEO.

Madeira mahogany or Vinacito, *Persea indica* Spreng.

Mahogany or Andaman Padouk, *Pterocarpus dalbergioides* Roxb. and *Pterocarpus indicus* Willd.

Borneo mahogany, Palo Maria or Poon, *Calophyllum inophyllum* L.

East Indian mahogany, *Soymida febrifuga* A. Juss.

Indian mahogany or Toon, *Cedrela toona* L.
Indian mahogany, *Melia composita* Willd.
Mahogany, Jackwood, or Orangewood, *Artocarpus integrifolia* L.

FROM AFRICA.

African mahogany, *Khaya grandifolia* Stapf.
African mahogany or Ibeka, *Khaya klainei* Pierre and *Khaya euryphylla* Harms.
African mahogany, *Pseudocedrela utilis* D. & S.
African mahogany, *Ricinodendron africanus* Muell.
African mahogany, Kino, Boi, or Okwen, *Ricinodendron hendelotti* Pierre.
African mahogany or Opapao, *Afzelia africana* S.
African mahogany or Cedar, *Trichilia pricuriana* A. Juss.
Agonokwi or Emido, *Mimusops multinervis* Baker.
Benin or Gold Coast mahogany, *Khaya grandis* Stapf.
Cail-Cedra or un bel Acajou, *Entandrophragma candolleana* De Will.
Dita or Detarr mahogany, *Detarium senegalense* Gmel.
Ory Zone mahogany or Cedar,[1] *Pseudocedrela kotschyi* (Schweinf.) Harms.
Gambia or Senegal mahogany, Cailcedra, Hie, Jallow, Dubina, or Oganwo, *Khaya senegalensis* A. Juss.
Gogo or African mahogany, *Carapa gogo* A. Chev.
Konta, Bendiguri, or Aligna, *Afzelia bracteata* Vog.
Natal mahogany, *Kiggelaria drageana* Turea.
Nigeria mahogany, *Khaya purchii* Stapf.
Obega or Gaboon mahogany, *Entandrophragma pierrei* Chevalier.
Okume, African cedar, or Libreville mahogany, *Boswellia klaineana.*
Punkwa and Tiama-tiama, *Pseudocedrela cylindrical* D. & S.
Quibaba da Questa, *Entandrophragma angolense* C. DC.
Sapeli, Ikwapolo, or Azore, *Entandrophragma candollei* Harms.
West African mahogany or cedar, *Pseudocedrela excelsa* D. & S.
White mahogany, *Piptadenia africana* Hook.
White mahogany or Incense tree, *Santiriopsis klainei* Pierre.
White mahogany or Quibaba da Mussangue, *Khaya anthotheca* C. DC.

FROM AUSTRALIA.

Australian mahogany, *Dysoxylon fraserianum* Benth.
Bastard mahogany, *Eucalyptus botryoides* Sm.
Red mahogany, *Eucalyptus resinifera* Sm.
Red mahogany or Tallow wood, *Eucalyptus microcorys* F. v. M.
Swamp mahogany, *Tristania laurina* R. Br.
Swamp mahogany, *Eucalyptus botryoides* Sm.
White mahogany, *Eucalyptus robusta.*

FROM PHILIPPINE ISLANDS.

Lumbayao mahogany, *Tarrietia sylvatica* (Vid.) Merr, or *javonica* Bl.
Padouk, Red narra or Tenasserim mahogany, *Pterocarpus indicus* Willd.
Philippine mahogany, Tanguile, or Balacbaccan, *Shorea polysperma* (Blanco) Merrill.
Philippine mahogany, Mangachapuy, or Red lauan, *Shorea negrosensis* Foxw.

FROM UNITED STATES AND CANADA.

Coffeetree or mahogany, *Gymnocladus dioicus* (L.) Koch.
Red gum, *Liquidambar styraciflua* Linn.

[1] This wood is very seldom exported on account of the small size of the tree. Locally the wood is highly esteemed and is preferred to that of *Afzelia africana,* which is a splendid wood and is used extensively.

Mahogany, Yellow birch, or Mountain birch, *Betula lutea* Michx. f.
Mountain birch or Sweet birch, *Betula lenta* L.
Western sumach, *Rhus integrifolia* (*Nutt.*) Benth. & Hook.
Mountain mahogany, *Cercocarpus ledifolius* Nutt.
Valley mahogany, *Cercocarpus parvifolius* Nutt.

FROM MEXICO, CENTRAL AMERICA, AND WEST INDIES.

Indian mahogany or Spanish cedar, *Cedrela odorata* L.
Madeira (mahogany), *Tamarindus indicus* L.
Horseflesh mahogany, *Caesalpina* sp.
Espave mahogany, *Anacardium rhinocarpus* DC.
White mahogany or Jenicero, *Tabebuia donnell-smithii* Rose.
Balata, Bully, or Bulletwood, *Mimusops globosa* Gaertner.
Sabicu (Bahama), *Lysiloma sabicu* Benth.
Sabicu Cuban), *Pithecolobium arboreum* (L.) Urb.
Santa maria, *Calophyllum calaba* Jacq.

FROM SOUTH AMERICA.

Horseflesh mahogany, *Swartzia tomentosa* D. C.
Colombian mahogany, *Cariniana pyriformis* Miers.
Demerara mahogany, Crabwood, or Carapa, *Carapa guianensis* Aubl.
Cumussin, *Carapa grandiflora* Mart.
Jacariuba, *Calophyllum brasiliense* Camb.

Of the 61 species listed, 24 belong to the same family as true mahogany, but none to the same genus—*Swietenia*. The next most important family group is *Leguminosae*, of which 12 species are represented in the foregoing list. Unfortunately, not all of the technical names of the trees can be given, since in some localities, especially in West Africa, the identity of a good many has not yet been determined. In fact, the actual source of a number of "mahoganies" from West Africa is unknown except to a few native merchants who control the output. The following list shows the different families to which the so-called "mahoganies" of commerce belong:

Family.	Genera.	Species.
Meliaceae (Mahogany, Spanish cedar)	10	24
Leguminosae (Locust, Judas tree)	10	12
Myrtaceae (Eucalyptus, pimento)	2	6
Anacardiaceae (Sumach)	2	2
Burseraceae (Gumbo limbo, or West Indian birch)	2	2
Rosaceae (Apple, pear)	2	2
Sapotaceae (Chicle tree, sapodilla)	2	2
Euphorbiaceae (Castor oil plant, crotons)	1	2
Sterculiaceae (Cocoa, cola)	1	2
Dipterocarpaceae (Borneo camphor tree)	1	2
Betulaceae (Birch, alder)	1	2
Moraceae (Mulberry, osage orange)	1	1
Lauraceae (Sassafras, red bay)	1	1
Guttiferae (St. John's wort, palo maria)	1	3
Flacourtiaceae (Arnotto)	1	1
Bignoniaceae (Catalpa, trumpet creeper)	1	1
Lecythidaceae (Monkey-pod tree, Brazil-nut tree)	1	1
Hamamelidaceae (Red gum)	1	1
	41	67

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